AN ROINN OIDEACHAIS

(Department of Education).

BRAINNSE AN MHEADHON-OIDEACHAIS

(Secondary Education Branch).

LEAVING CERTIFICATE EXAMINATION, 1940.

HONOURS.

APPLIED MATHEMATICS.

THURSDAY, 20th JUNE.—AFTERNOON 4 TO 6 P.M.

Not more than *six* questions may be answered. All questions are of equal value.

Mathematical Tables may be obtained from the Superintendent.

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1. If two bodies A, B are moving with velocities u_1, u_2, in directions inclined at angles, θ_1, θ_2 respectively to the horizontal, find the horizontal and vertical components of the velocity of A relative to B.

To a man walking at 3 miles per hour the rain appears to fall vertically; when he increases his speed to 4 miles per hour (in the same direction) the direction of the rain's velocity relative to the man is 45° to the horizontal: find the velocity of the rain in magnitude and direction.

2. A body of mass 56 lb. rests on a rough plane inclined at 25° to the horizon, being just prevented from sliding down the plane by a force of 15 lb. wt. acting up the plane. Find by a graphic construction the angle of friction and the force that will just drag the body up the plane. Verify your answers by calculation.

3. A mass of 8 ounces after falling freely through one foot begins to raise a mass of 9 ounces which is connected with it by means of a light inextensible string passing over a smooth fixed pulley. Prove that the 9 ounce mass will have returned to its original position at the end of 4 seconds approximately.

4. Define "Work" and "Power".

A train of mass 90 tons (and the engine) is driven up an incline of 1 in 210 at a uniform speed of 30 miles per hour by an engine working at the rate of 240 H.P. Apart from the force impeding motion due to the weight of the train and engine, calculate in lb. per ton the resistance due to other causes.

5. From the top of a vertical cliff 82 feet above sea level a stone is thrown so that it starts with a velocity of 64 ft. per second at an angle of 30° upward from the horizontal and outward towards the sea. Find, to the nearest foot, how far from the bottom of the cliff it strikes the sea.

6. A thin plate ABCD has the form of a trapezium in which the angles at A and B are right angles and the sides AD, AB and BC are 4, 3 and 7 inches long respectively. Find the distances of the centre of gravity of the plate from AB and BC.

If the plate is suspended from C, find the angle between CB and the vertical.

7. If a particle be tied by a string to a fixed point and allowed to oscillate through a small angle about the vertical position, show that the time of a complete oscillation is $2\pi\sqrt{\frac{l}{g}}$, where l is the length of the string.

Show that the length of a seconds pendulum is about 99 centimetres.

8. Two equal particles are connected by a light inextensible string which passes over a smooth pulley fixed at the top of a rough plane which is inclined to the horizontal at an angle of 60°. The coefficient of friction is $\frac{1}{4}$. One particle can move along a line of greatest slope of the plane whilst the other hangs freely. Find the acceleration of the particles when the particle on the plane is moving up. Find also the acceleration of the centre of inertia of the particles.

9. A particle of mass m is attached to a fixed point by means of a string of length l and hangs freely. It is then projected horizontally with velocity u. Find the least value of u required so that the particle may describe a circle completely and show that for complete revolutions the string must, at the least, be able to bear a load equal to six times the weight of the particle.